PATENT COOPERATION TREA

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 07 May 2001 (07.05.01)	
International application No. PCT/GB00/02767	**Applicant's or agent's file reference** N.77491A MN
International filing date (day/month/year) 19 July 2000 (19.07.00)	**Priority date** (day/month/year) 27 August 1999 (27.08.99)
Applicant NOBLE, Julia, Alison et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

21 March 2001 (21.03.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Juan Cruz
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992) GB0002767

3

PATENT COOPERATION TREATY

PCT

REC'D 12 OCT 2001
WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
N.77491A MN		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/02767	19/07/2000	27/08/1999
International Patent Classification (IPC) or national classification and IPC G06T7/20		
Applicant ISIS INNOVATION LIMITED		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☒ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
21/03/2001	11.10.2001
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer Chateau, J-P Telephone No. +31 70 340 2980

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/02767

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-24 as originally filed

Claims, No.:

1-48 as originally filed

Drawings, sheets:

1-19 as originally filed

2. With regard to the **language**; all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

☐ restricted the claims.

☐ paid additional fees.

☐ paid additional fees under protest.

☒ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

☐ complied with.

☐ not complied with for the following reasons:

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

☐ all parts.

☒ the parts relating to claims Nos. 1-21,41-43.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	8-21
	No:	Claims	1-7,41-43
Inventive step (IS)	Yes:	Claims	12,15,21
	No:	Claims	1-11,13,14,16-20,41-43

Industrial applicability (IA)	Yes:	Claims	1-21,41-43
	No:	Claims	

2. Citations and explanations
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents :

D1:"Shape-based tracking of left ventricular wall motion"; John C. McEachen,II et al.;IEEE Trans. on Medical Imaging, Vol. 16, N°3, June 1997, pages 270-283

D2:"Robust contour tracking in echocardiographic sequences"; Gary Jacob et al.; 6th IEEE International conference om Computer Vision ICCV 98', Bombay, 4-7 Jan 1998,; IEEE, New York; pages 408-413

1. Novelty-Inventive step

D1 discloses a method of analysing a sequence of images of an internal body organ in non-rigid motion comprising the steps of (Abstract, lines 1-7) :

- detecting the boundary of the organ in each image of the sequence; and
- automatically calculating the amount of movement throughout the sequence of each of a plurality of clinically relevant segments of the detected boundary.

Therefore, the subject-matter of Claim 1 is not new (Article 33.2 PCT).

D1 discloses also the steps of Claim 2, i.e displaying graphically the calculated amount of movement of each of the clinically significant segments (Fig. 3). Therefore, the subject-matter of Claim 2 is not new (Article 33.2 PCT).

D1 discloses also the calculation of a mean shape, which means the shape corresponding to the average of the movement of the boundary (Fig. 1). Therefore, the subject-matter of Claim 3 is not new (Article 33.2 PCT).

Dependent claims 4-7 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and, the reasons being as follows: In document D1, fig. 8, the result of calculation of the maximal excursion of the clinically significant segments is displayed, the

organ being an animal heart and the variation of the amount of movement is displayed too.

Furthermore, images are produced by MR-based imaging (page 278, right-hand column, lines 8-12).

Therefore , the subject-matter of claims 4-7 is not new (Article 33.2 PCT).

Dependent claims 8-11,13,14,16-20 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, the reasons being as follows: D2 discloses a method of boundary tracking in which a spline curve is fitted to the boundary , a shape-space representation of the movement of the spline curve is calculated and the suggestion of the use of principal component analysis of the movement of the spline curve is made (page 409, left-hand column, paragraph 2.1) . D2 discloses also the step of defining a different shape-space and calculating the shape vector corresponding to the shape space (page 410, right-hand column, paragraph 3.2).

The subject-matter of claims 41-43 is not new (Article 33.2 PCT) because D2 discloses all the steps of these claims (pages 408-412)

Re Item VIII

Certain observations on the international application

Although claims 1 and 41 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

Hence, claims 1 and 41 do not meet the requirements of Article 6 PCT.

In claims 10,11,18,19, the wording "shape space space" should read "shape space" (Article 6 PCT). Furthermore, in Claim 10, the wording "movement the spline curve" should read "movement of the spline curve (Article 6 PCT.).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 March 2001 (08.03.2001)

PCT

(10) International Publication Number
WO 01/16886 A3

(51) International Patent Classification[7]: G06T 7/20, 5/00

(21) International Application Number: PCT/GB00/02767

(22) International Filing Date: 19 July 2000 (19.07.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
9920401.8 27 August 1999 (27.08.1999) GB

(71) Applicant *(for all designated States except US)*: **ISIS INNOVATION LIMITED** [GB/GB]; Ewert House, Ewert Place, Summertown, Oxford OX2 7BZ (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **NOBLE, Julia, Alison** [GB/GB]; Dept. of Engineering Science, University of Oxford, Parks Road, Oxford OX1 3PJ (GB). **JACOB, Gary** [GB/GB]; 81 Walmington Fold, Woodside Park, London N12 7LD (GB).

(74) Agents: **NICHOLLS, Michael, John** et al.; J.A. Kemp & Co., 14 South Square, Gray's Inn, London WC1R 5LX (GB).

(81) Designated States *(national)*: JP, US.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published:
— *with international search report*

(88) Date of publication of the international search report:
1 November 2001

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 01/16886 A3

(54) Title: NON-RIGID MOTION IMAGE ANALYSIS

(57) Abstract: A method of automatically detecting and tracking the endocardial and epicardial boundaries of the left ventricle in an echocardiographic image sequence. The endocardial boundary is manually located in some frames of the image sequence, a B-spline curve is fitted to the manually located boundary and a shape-space for the deformation of the boundary through the sequence is calculated by a principal component analysis (PCA) of the motion. The location of the endocardial boundary for all frames in the sequences is then predicted using the shape-space and this prediction is adjusted by searching for image features, such as sharp changes in intensity, in the vicinity of the prediction. The amount of movement of the endocardial boundary in each clinically significant segment of the ventricular wall is obtained by measuring the degree of movement of the control points for the spline in that segment, and also monitoring the variation in the amount of movement between the control points for each spline.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/02767

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06T7/20 G06T5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
INSPEC, WPI Data, PAJ, IBM-TDB, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MCEACHEN J C II ET AL: "Shape-based tracking of left ventricular wall motion" IEEE TRANSACTIONS ON MEDICAL IMAGING, JUNE 1997, IEEE, USA, vol. 16, no. 3, pages 270-283, XP002155446 ISSN: 0278-0062 page 272, left-hand column, line 16 - line 26 figures 1,3 --- -/--	1,2,6,7

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 April 2001	12 04 2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Chateau, J-P

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SETAREHDAN S K ET AL: "AUTOMATIC LEFT VENTRICULAR FEATURE EXTRACTION AND VISUALISATION FROM ECHOCARDIOGRAPHIC IMAGES" COMPUTERS IN CARDIOLOGY,US,NEW YORK, IEEE, 1996, pages 9-12, XP000687747 ISBN: 0-7803-3711-5 abstract page 11, left-hand column, paragraph 2.3 ---	8-21
X Y	JP 10 165401 A (GE YOKOGAWA MEDICAL SYST LTD.) 23 June 1998 (1998-06-23) the whole document ---	44 24
X	JACOB G ET AL: "Robust contour tracking in echocardiographic sequences" SIXTH INTERNATIONAL CONFERENCE ON COMPUTER VISION (IEEE CAT. NO.98CH36271), PROCEEDINGS OF IEEE 6TH INTERNATIONAL CONFERENCE ON COMPUTER VISION, BOMBAY, INDIA, 4-7 JAN. 1998, pages 408-413, XP002155450 1998, New Delhi, India, Narosa Publishing House, India ISBN: 81-7319-221-9 cited in the application the whole document ---	41
X Y	US 5 669 382 A (RUPERT WILLIAM MELDRUM CURWEN ET AL.) 23 September 1997 (1997-09-23) claim 1 ---	22 23
Y	CHALANA V ET AL: "A MULTIPLE ACTIVE CONTOUR MODEL FOR CARDIAC BOUNDARY DETECTION ON ECHOCARDIOGRAPHIC SEQUENCES" IEEE TRANSACTIONS ON MEDICAL IMAGING,US,IEEE INC. NEW YORK, vol. 15, no. 3, 1 June 1996 (1996-06-01), pages 290-298, XP000587923 ISSN: 0278-0062 page 292, right-hand column, paragraph B. -page 293, right-hand column, paragraph D. ---	24
Y	KASS M ET AL: "SNAKES: ACTIVE CONTOUR MODELS" LONDON, JUNE 8 - 11, 1987,WASHINGTON, IEEE COMP. SOC. PRESS,US, vol. CONF. 1, 8 June 1987 (1987-06-08), pages 259-268, XP000971219 abstract -----	23

INTERNATIONAL SEARCH REPORT

national application No.
PCT/GB 00/02767

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-21,41-43

A method of analysing a sequence of images of an internal body organ in non-rigid motion, comprising the steps of:
- detecting the boundary of the organ in each image of the sequence; and automatically calculating the amount of movement through the sequence of each of a plurality of clinically significant segments of the detected boundary;

2. Claims: 22-40,44-48

A method of analysing a sequence of images of a deformable object in non-rigid motion to detect inner and outer boundaries of a wall of the object; method of contructing a shape space representation of the variation through the sequence of the distance between the two boundaries

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 00/02767

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 10165401 A	23-06-1998	NONE	
US 5669382 A	23-09-1997	CN 1194812 A	07-10-1998
		DE 19746939 A	28-05-1998
		JP 10229979 A	02-09-1998

Fig.1(B).

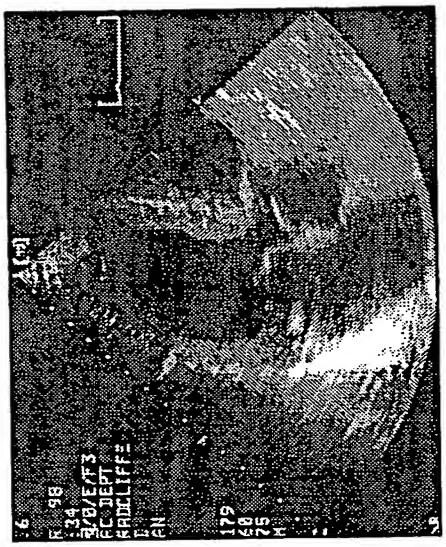


Fig.1(D).

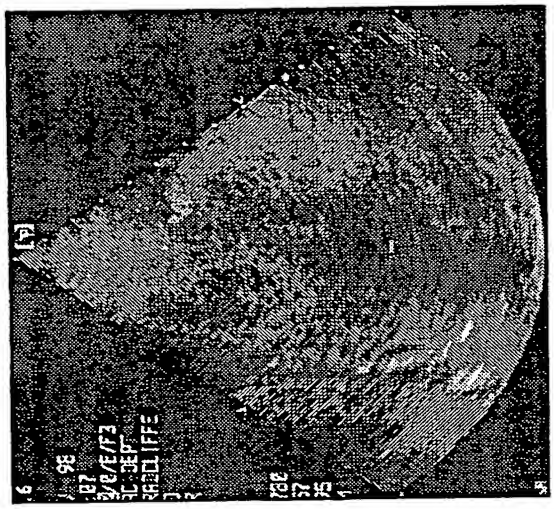


Fig.1(A).

Fig.1(C).

Fig.2(A).

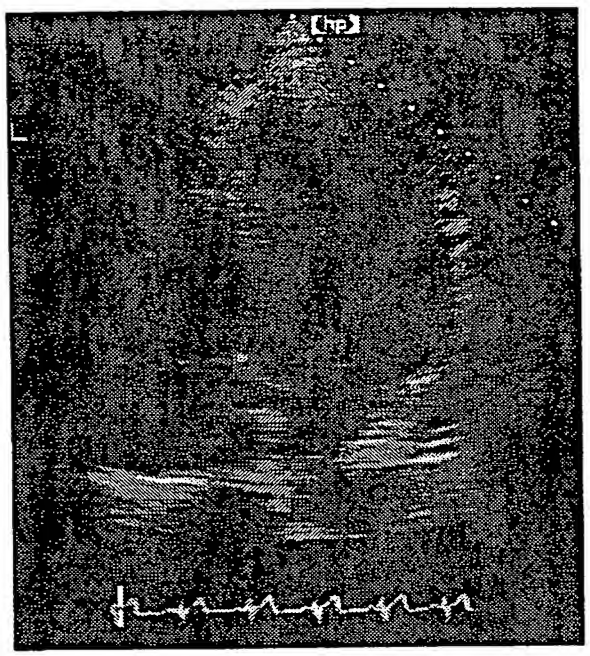


Fig.2(B).

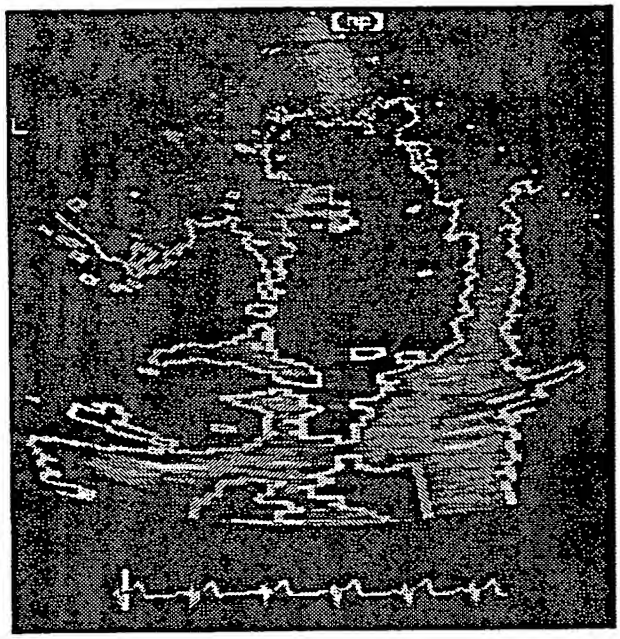


Fig.2(C).

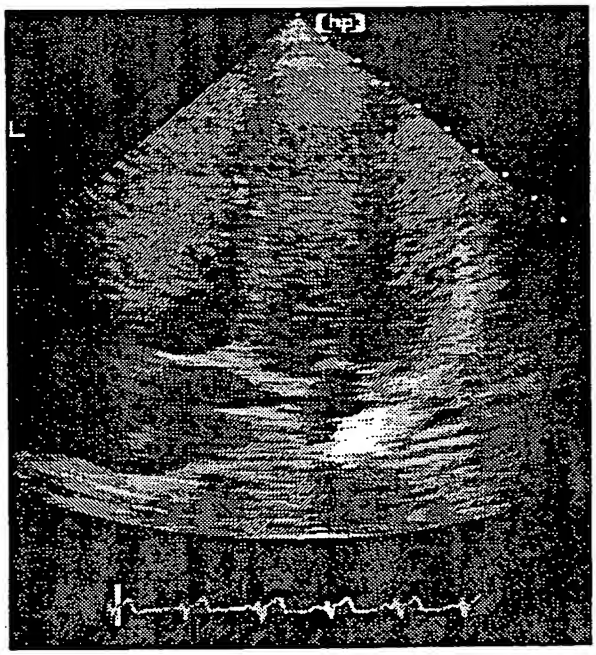


Fig.2(D).

Fig.3(A).

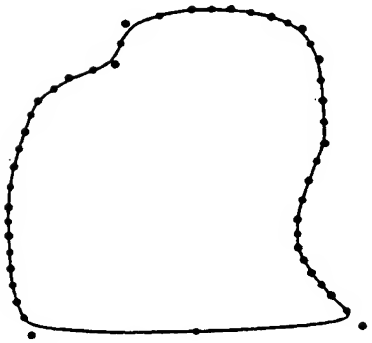
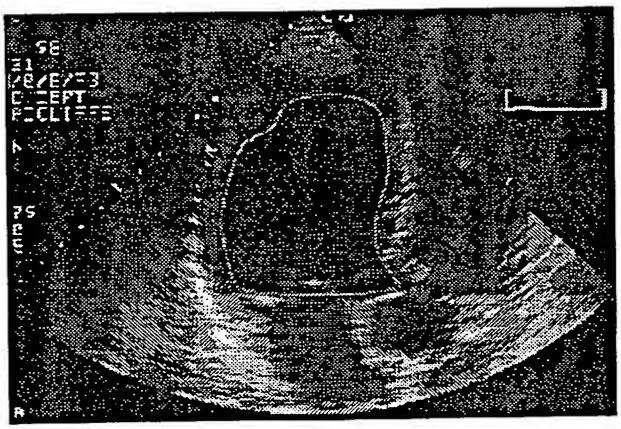


Fig.3(B).



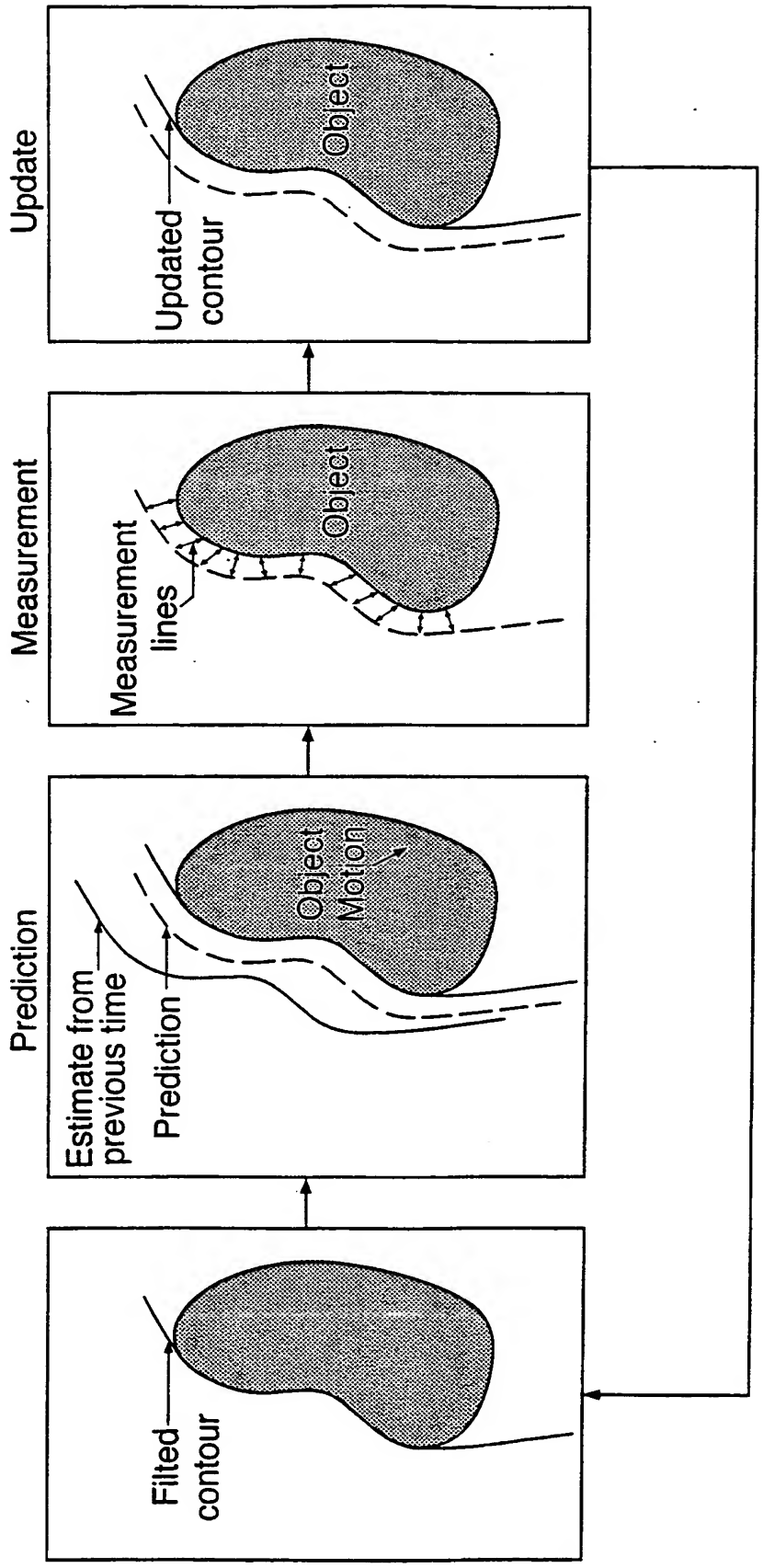

Update
Updated contour
Object
Measurement
Measurement lines
Object
Prediction
Estimate from previous time
Prediction
Object Motion
Filted contour

Fig.4.

Fig.5.

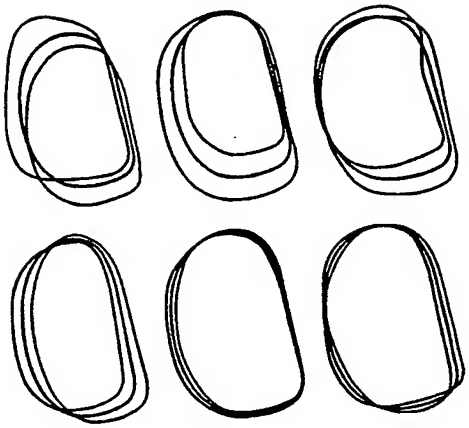


Fig.6.

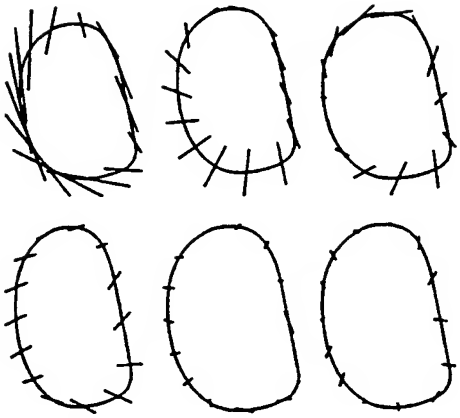


Fig.7(A).

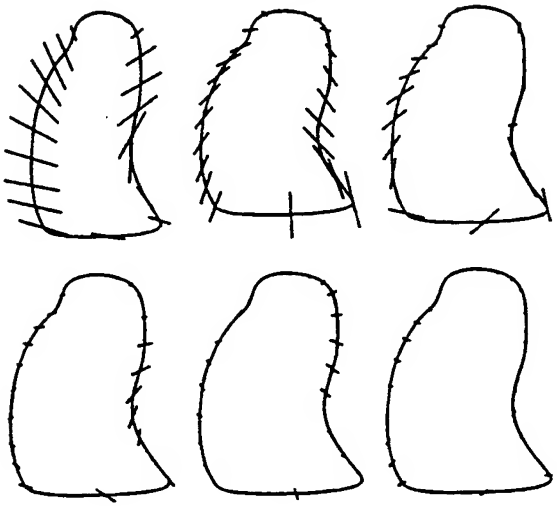
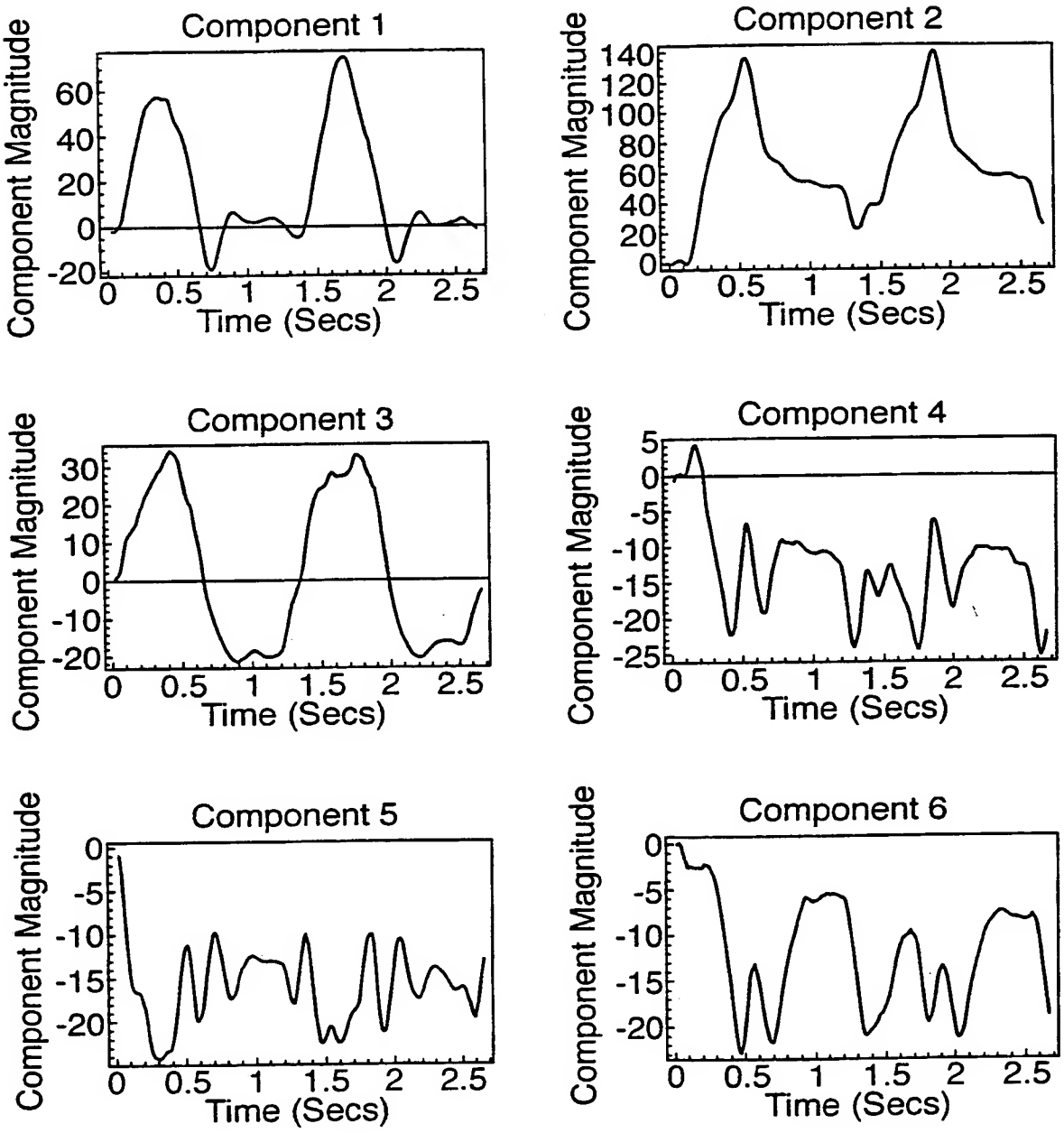


Fig.7(B).


Component 1
Component Magnitude
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40
20
0
-20
0 0.5 1 1.5 2 2.5
Time (Secs)
Component 2
Component Magnitude
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120
100
80
60
40
20
0
0 0.5 1 1.5 2 2.5
Time (Secs)
Component 3
Component Magnitude
30
20
10
0
-10
-20
0 0.5 1 1.5 2 2.5
Time (Secs)
Component 4
Component Magnitude
5
0
-5
-10
-15
-20
-25
0 0.5 1 1.5 2 2.5
Time (Secs)
Component 5
Component Magnitude
0
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-15
-20
0 0.5 1 1.5 2 2.5
Time (Secs)
Component 6
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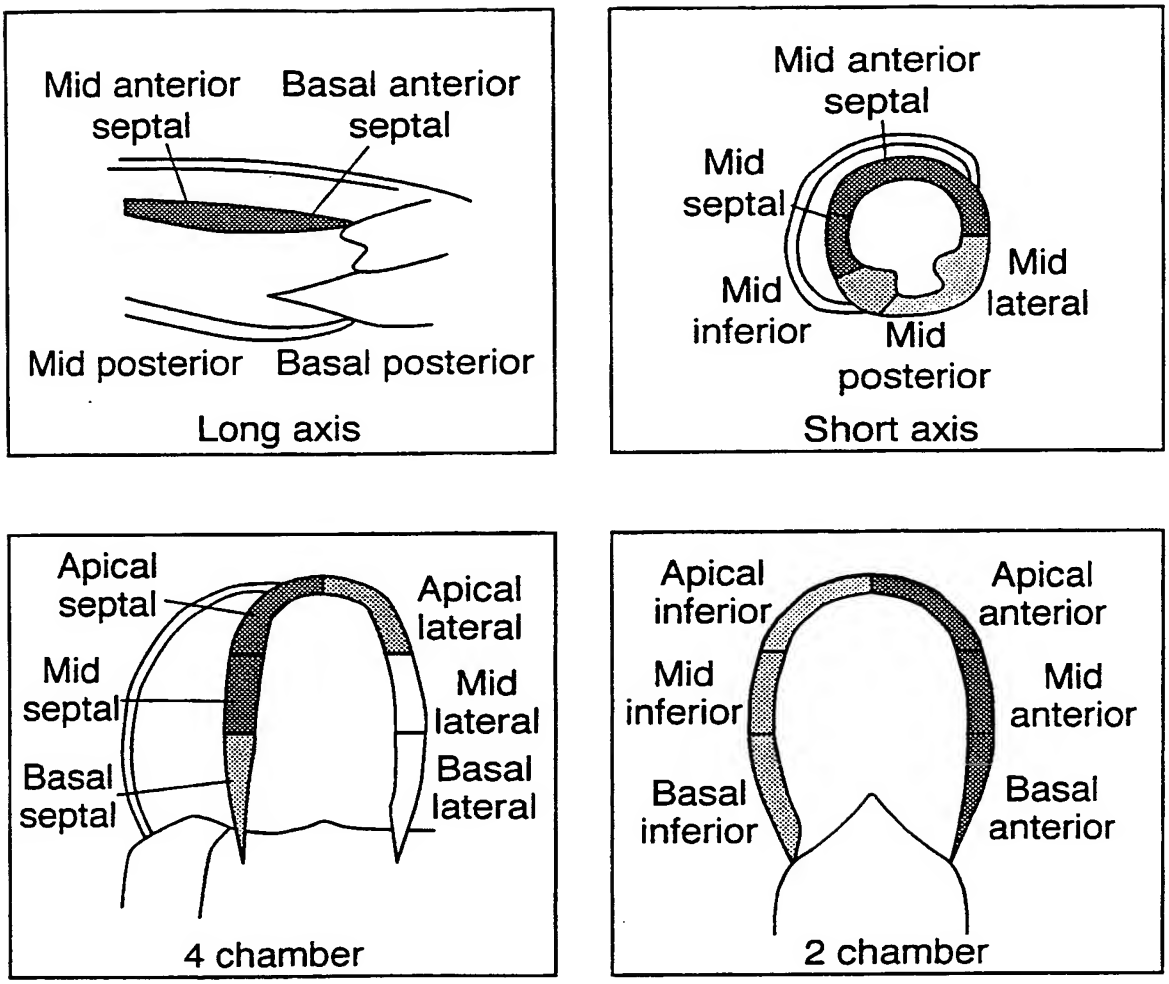
-10
-15
-20
0 0.5 1 1.5 2 2.5
Time (Secs)

Fig.8.



- Left anterior descending distribution
- Right coronary artery distribution
- Circumflex distribution
- Left anterior descending/circumflex overlap
- Left anterior descending/right coronary artery overlap

Fig.9.

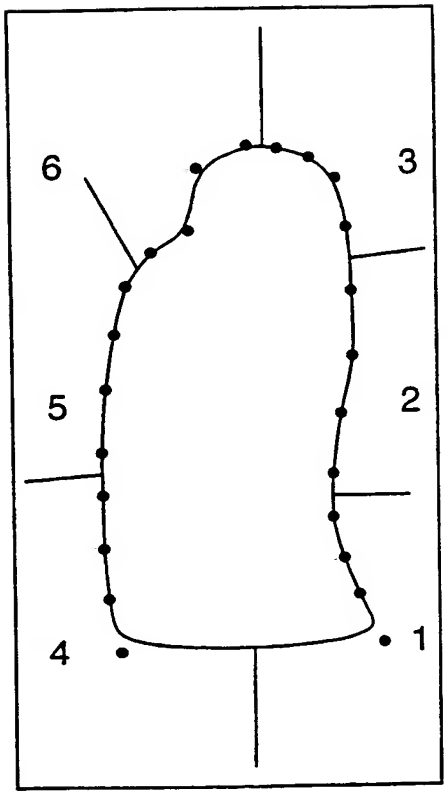
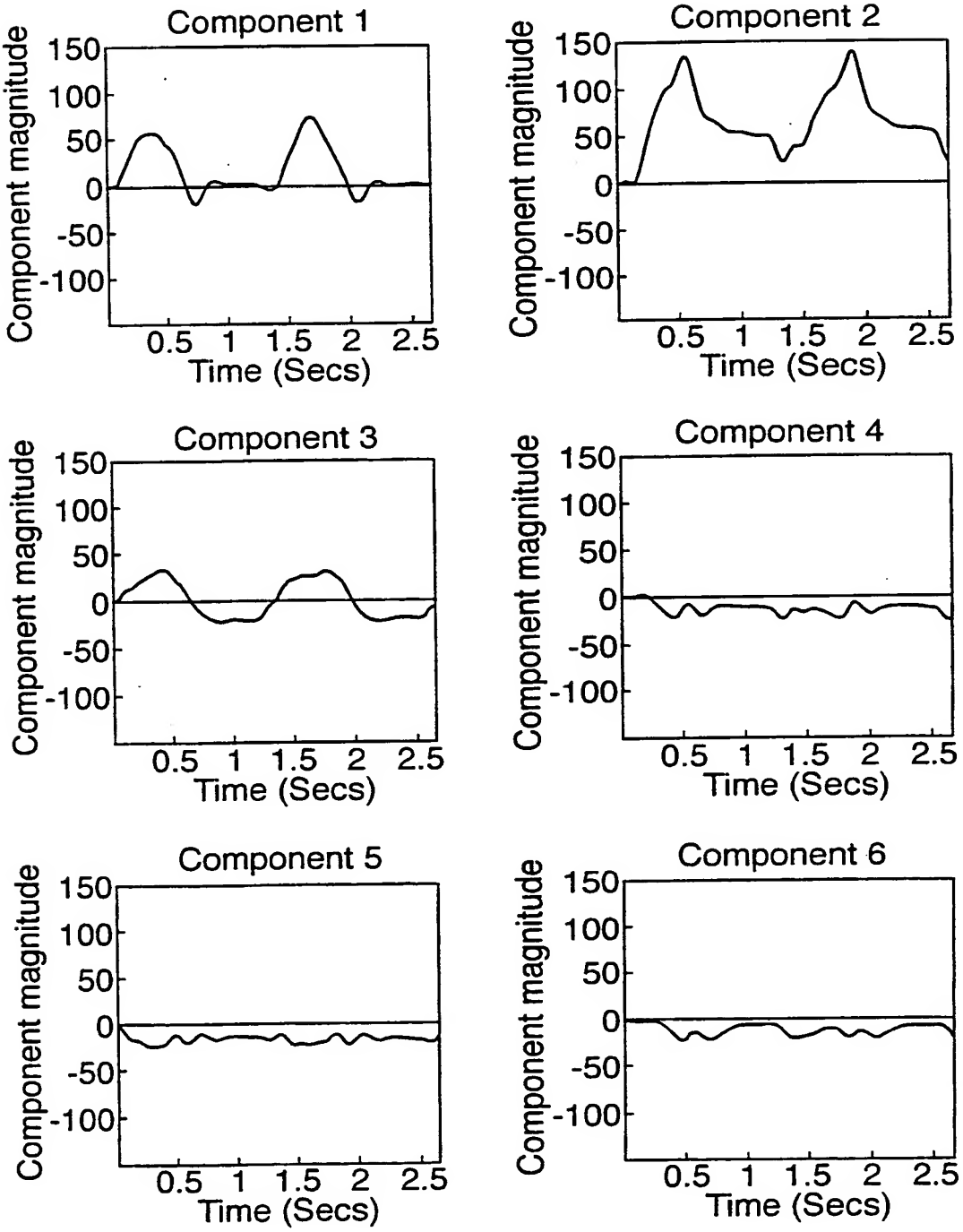


Fig.10(A).


Component 1
Component magnitude
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100
50
0
-50
-100
0.5 1 1.5 2 2.5
Time (Secs)
Component 2
Component magnitude
150
100
50
0
-50
-100
0.5 1 1.5 2 2.5
Time (Secs)
Component 3
Component magnitude
150
100
50
0
-50
-100
0.5 1 1.5 2 2.5
Time (Secs)
Component 4
Component magnitude
150
100
50
0
-50
-100
0.5 1 1.5 2 2.5
Time (Secs)
Component 5
Component magnitude
150
100
50
0
-50
-100
0.5 1 1.5 2 2.5
Time (Secs)
Component 6
Component magnitude
150
100
50
0
-50
-100
0.5 1 1.5 2 2.5
Time (Secs)

Fig.10(B).

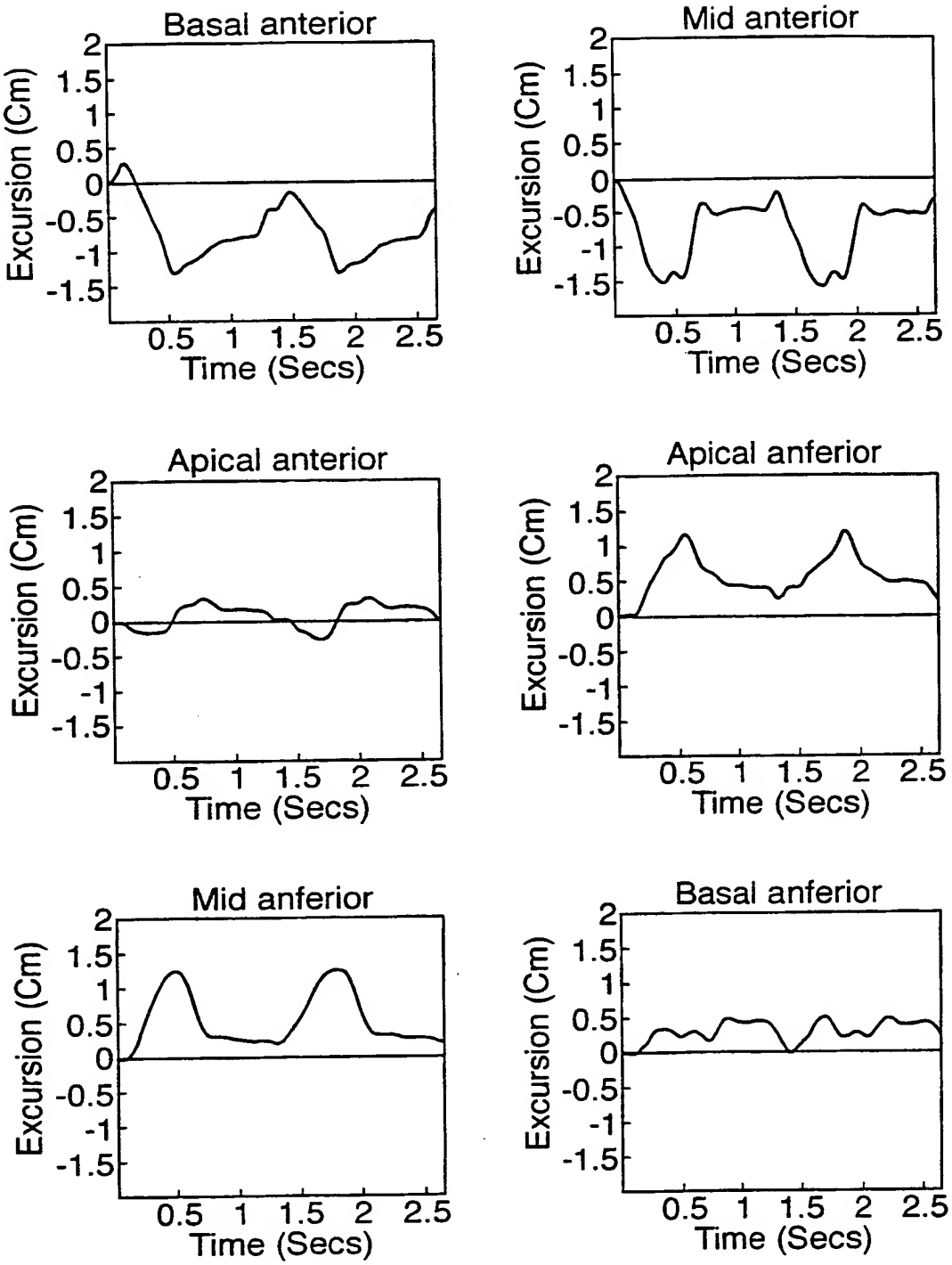

Basal anterior
Mid anterior
Apical anterior
Apical anferior
Mid anferior
Basal anferior
Excursion (Cm)
Time (Secs)
2
1.5
1
0.5
0
-0.5
-1
-1.5
0.5 1 1.5 2 2.5

Fig.11(A).

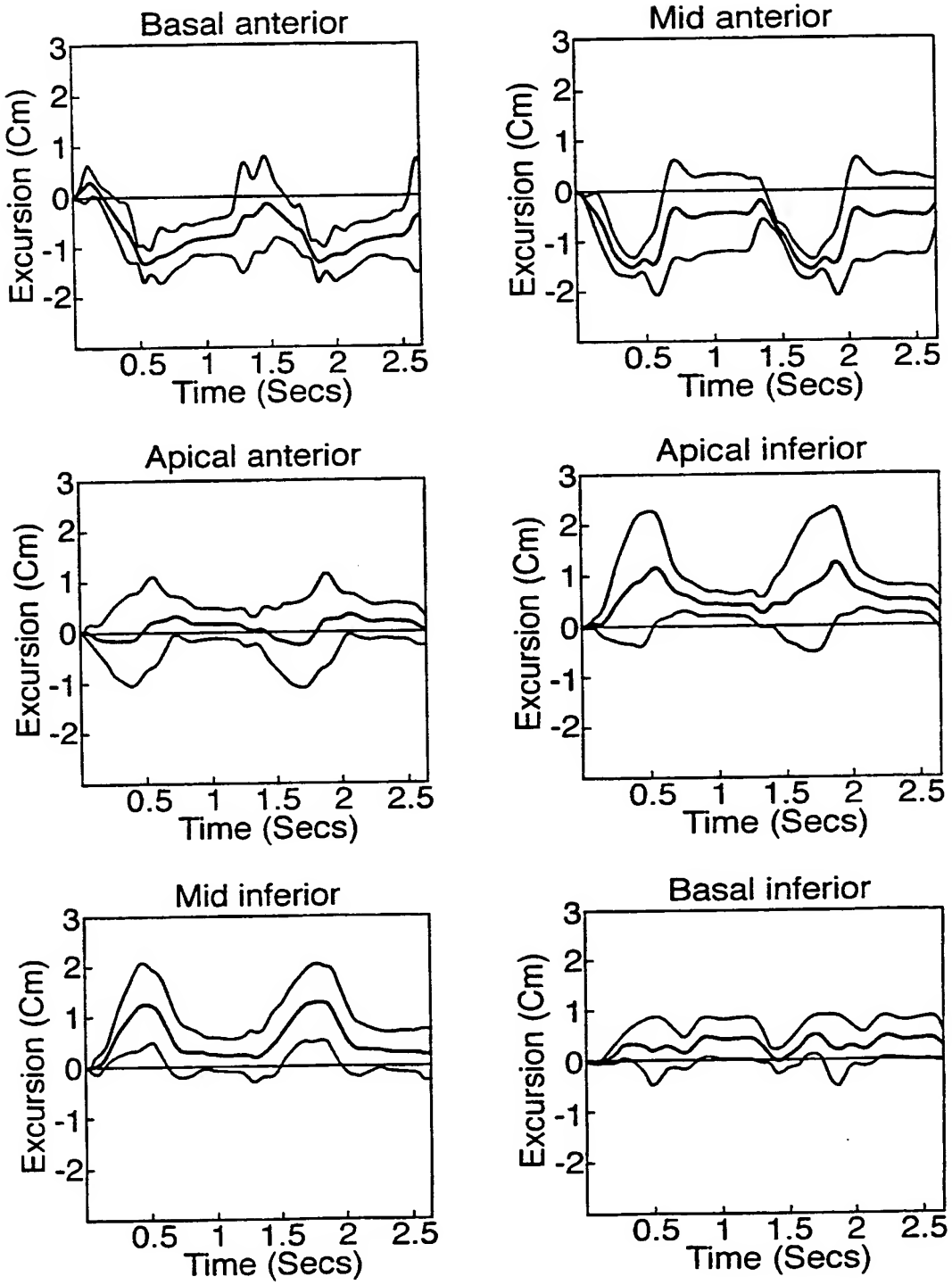

Basal anterior
Mid anterior
Apical anterior
Apical inferior
Mid inferior
Basal inferior
Excursion (Cm)
Time (Secs)
3
2
1
0
-1
-2
0.5
1
1.5
2
2.5

Fig.11(B).

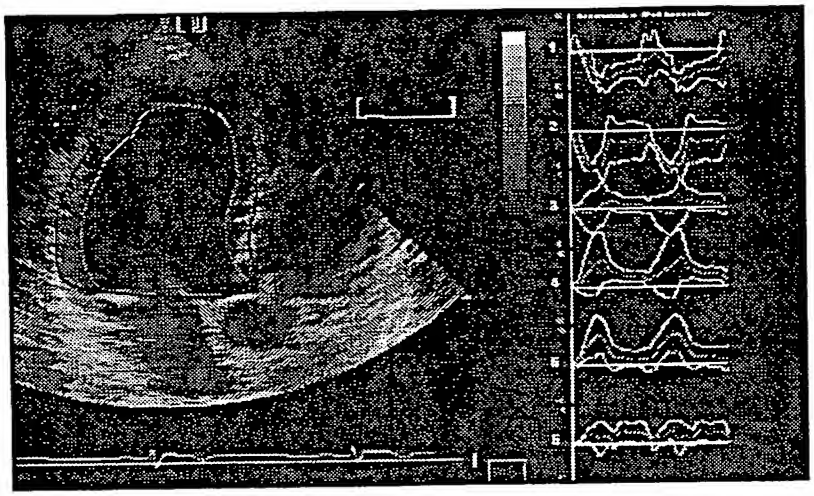


Fig.12.

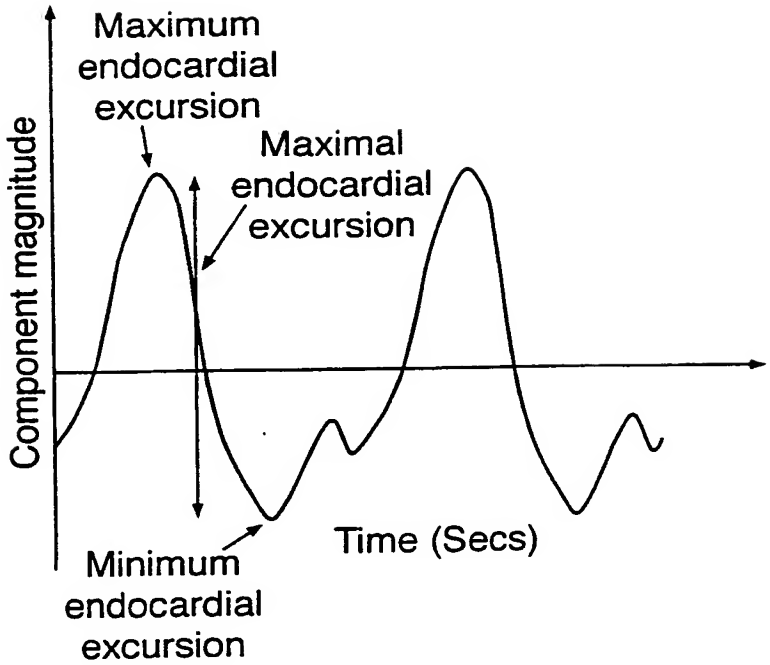


Fig.13(A).

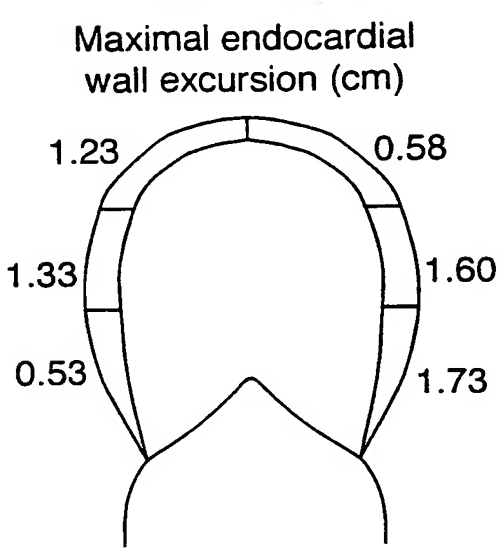


Fig.13(B).

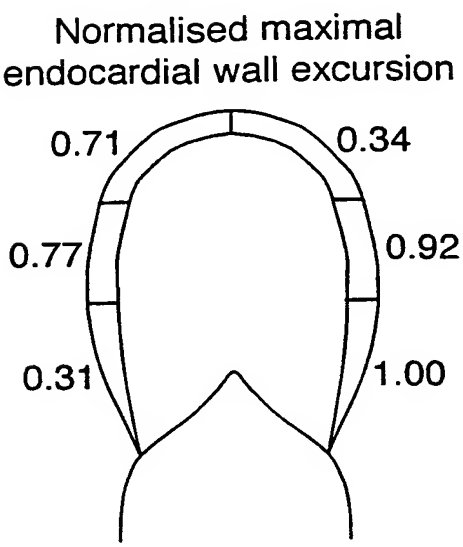


Fig.14.

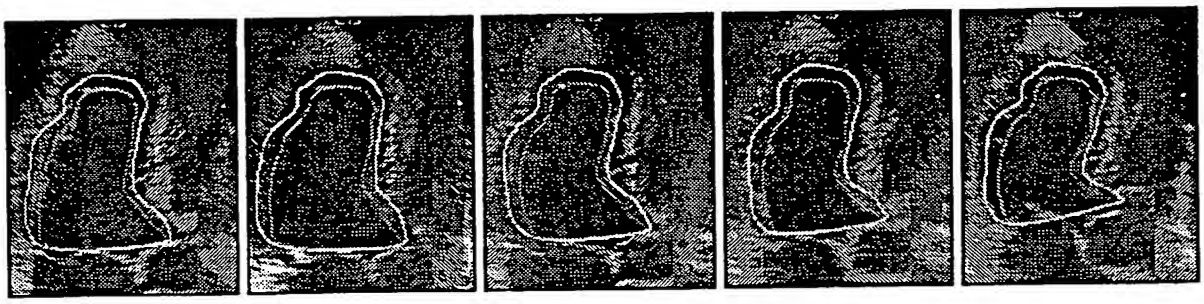


Fig.15.

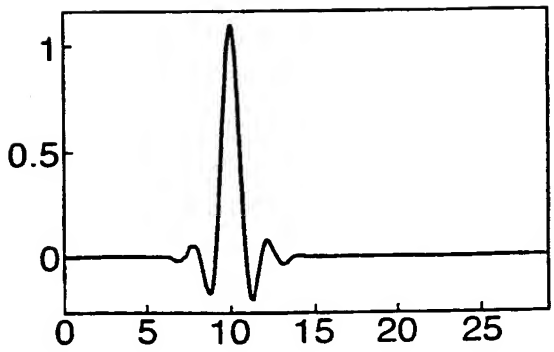


Fig.16.

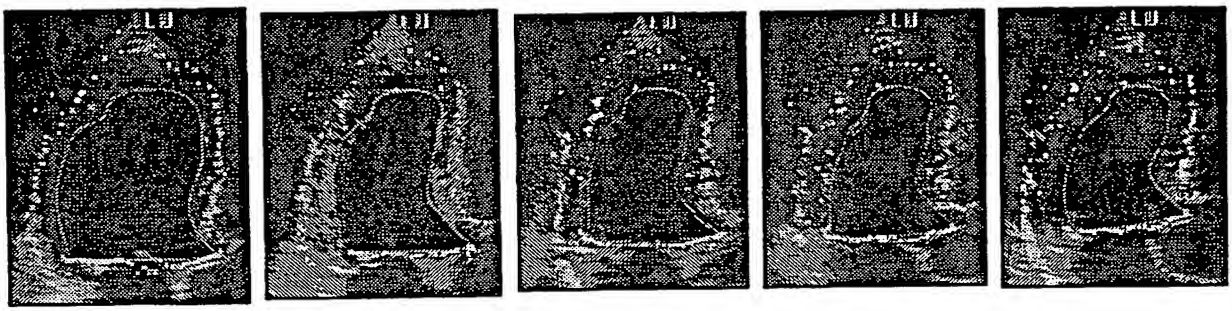
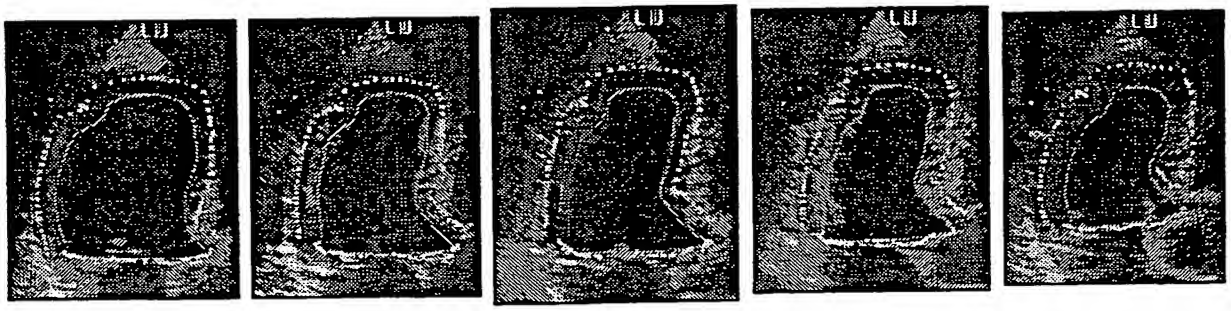


Fig.17.



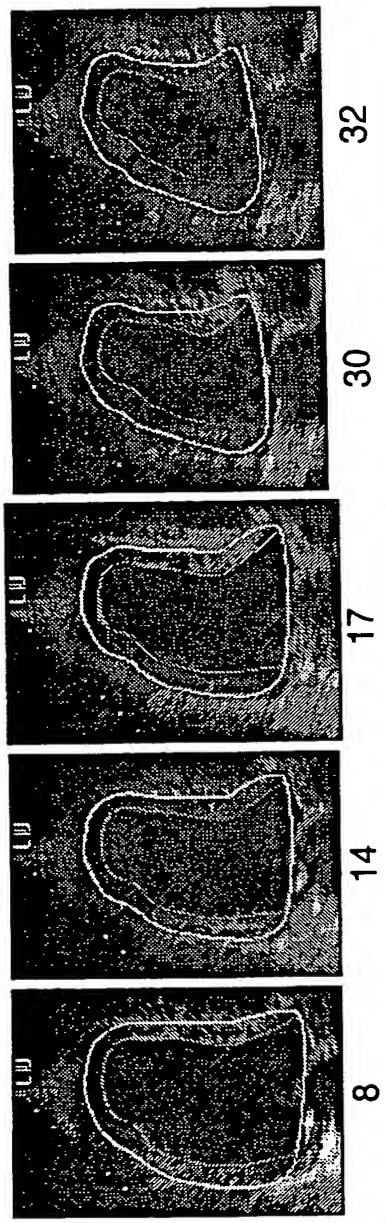


Fig.18(A).

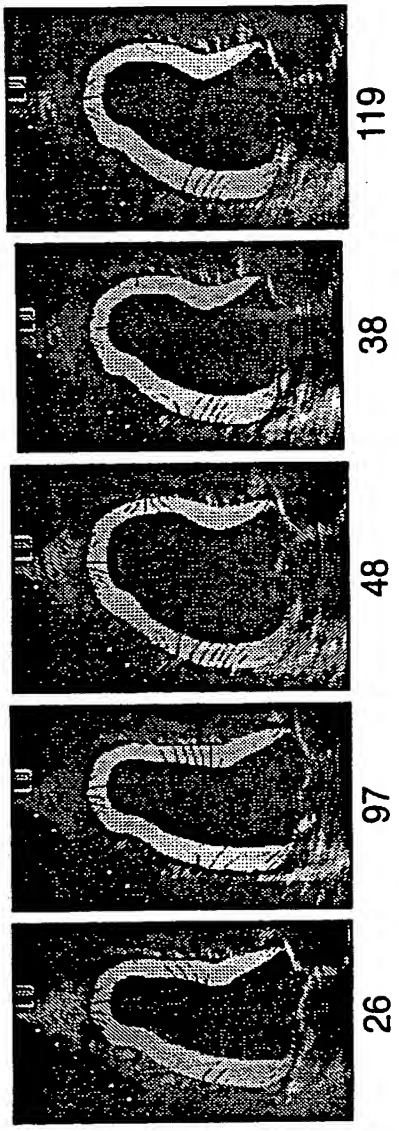


Fig.18(B).

Fig.19.

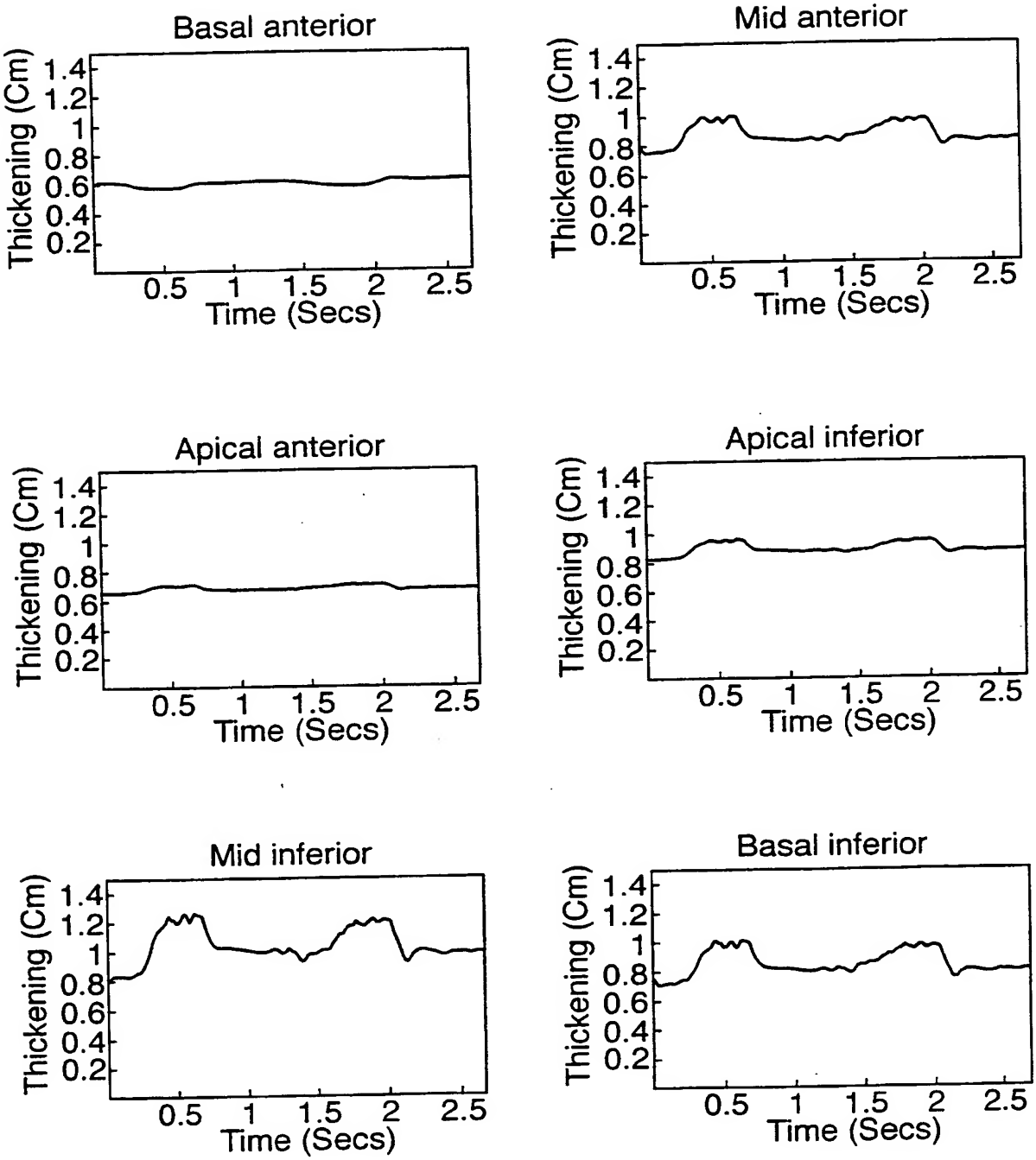

Basal anterior
Thickening (Cm)
1.4
1.2
1
0.8
0.6
0.4
0.2
0.5 1 1.5 2 2.5
Time (Secs)
Mid anterior
Thickening (Cm)
1.4
1.2
1
0.8
0.6
0.4
0.2
0.5 1 1.5 2 2.5
Time (Secs)
Apical anterior
Thickening (Cm)
1.4
1.2
1
0.8
0.6
0.4
0.2
0.5 1 1.5 2 2.5
Time (Secs)
Apical inferior
Thickening (Cm)
1.4
1.2
1
0.8
0.6
0.4
0.2
0.5 1 1.5 2 2.5
Time (Secs)
Mid inferior
Thickening (Cm)
1.4
1.2
1
0.8
0.6
0.4
0.2
0.5 1 1.5 2 2.5
Time (Secs)
Basal inferior
Thickening (Cm)
1.4
1.2
1
0.8
0.6
0.4
0.2
0.5 1 1.5 2 2.5
Time (Secs)

Fig.20.

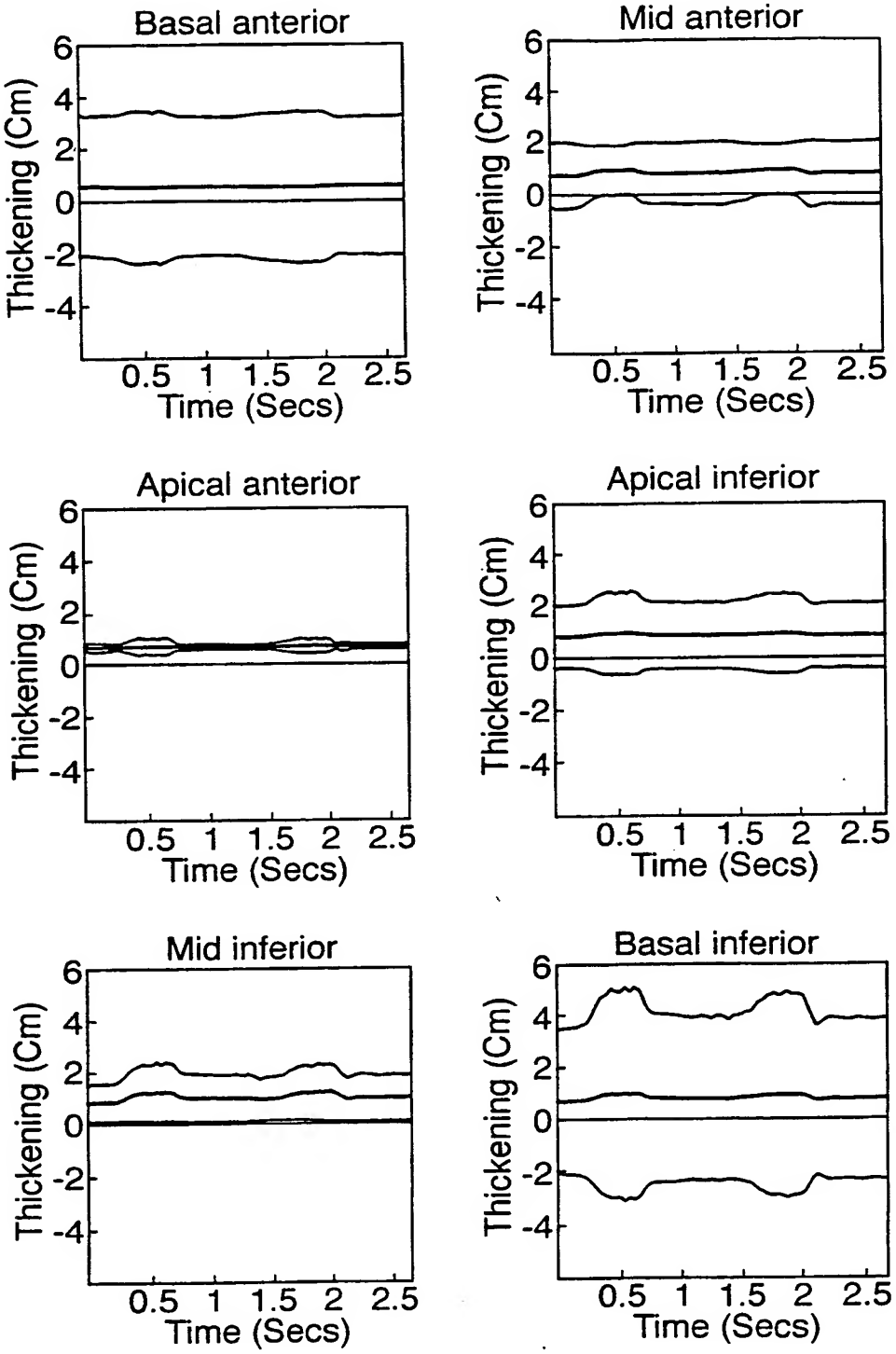

Basal anterior
Mid anterior
Apical anterior
Apical inferior
Mid inferior
Basal inferior
Thickening (Cm)
6
4
2
0
-2
-4
0.5 1 1.5 2 2.5
Time (Secs)

Fig.21.

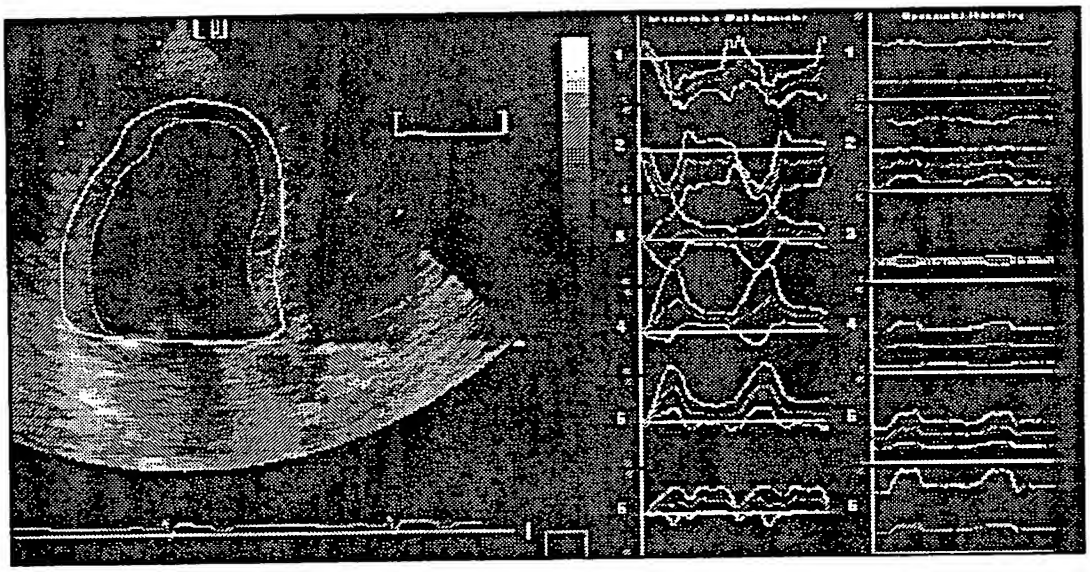


Fig.22(A).

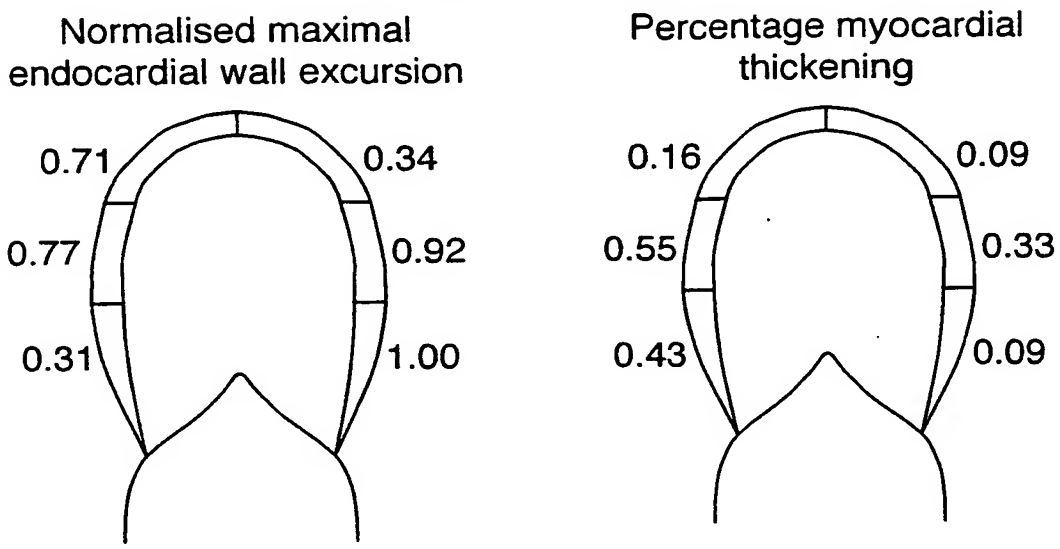
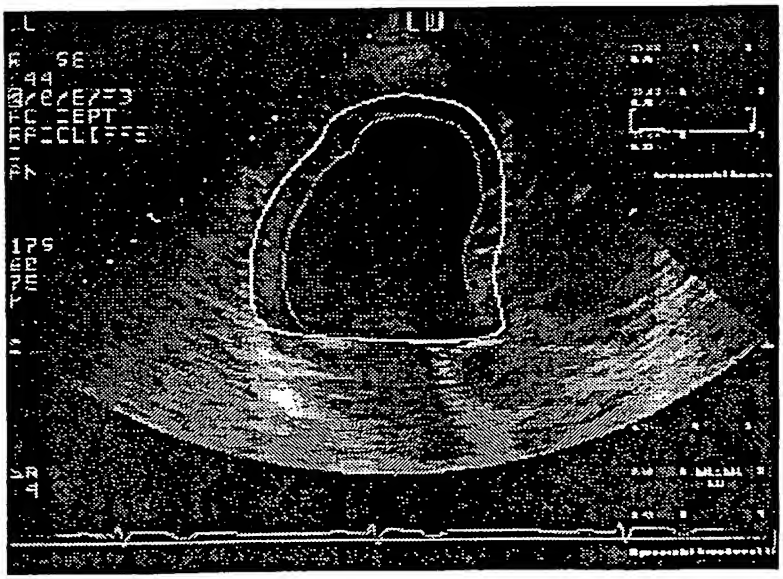


Fig.22(B).



PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
N.77491A MN		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 00/ 02767	19/07/2000	27/08/1999
Applicant		
ISIS INNOVATION LIMITED		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 6 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [X] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [ ] the text is approved as submitted by the applicant.

   [X] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. -

   [ ] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [X] None of the figures.

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

A method of automatically detecting and tracking the endocardial and epicardial boundaries of the left ventricle in an echocardiographic image sequence. The endocardial boundary is manually located in some frames of the image sequence, a B-spline curve is fitted to the manually located boundary and a shape-space for the deformation of the boundary through the sequence is calculated by a principal component analysis (PCA) of the motion. The location of the endocardial boundary for all frames in the sequences is then predicted using the shape-space and this prediction is adjusted by searching for image features, such as sharp changes in intensity, in the vicinity of the prediction. The amount of movement of the endocardial boundary in each clinically significant segment of the ventricular wall is obtained by measuring the degree of movement of the control points for the spline in that segment, and also monitoring the variation in the amount of movement between the control points for each spline.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 00/02767

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-21,41-43

A method of analysing a sequence of images of an internal body organ in non-rigid motion, comprising the steps of:
- detecting the boundary of the organ in each image of the sequence; and automatically calculating the amount of movement through the sequence of each of a plurality of clinically significant segments of the detected boundary;

2. Claims: 22-40,44-48

A method of analysing a sequence of images of a deformable object in non-rigid motion to detect inner and outer boundaries of a wall of the object; method of contructing a shape space representation of the variation through the sequence of the distance between the two boundaries

INTERNATIONAL SEARCH REPORT

[redacted]

International Application No
[redacted]/GB 00/02767

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06T7/20 G06T5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
INSPEC, WPI Data, PAJ, IBM-TDB, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MCEACHEN J C II ET AL: "Shape-based tracking of left ventricular wall motion" IEEE TRANSACTIONS ON MEDICAL IMAGING, JUNE 1997, IEEE, USA, vol. 16, no. 3, pages 270-283, XP002155446 ISSN: 0278-0062 page 272, left-hand column, line 16 - line 26 figures 1,3 --- -/--	1,2,6,7

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 April 2001	12. 04. 2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Chateau, J-P

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	SETAREHDAN S K ET AL: "AUTOMATIC LEFT VENTRICULAR FEATURE EXTRACTION AND VISUALISATION FROM ECHOCARDIOGRAPHIC IMAGES" COMPUTERS IN CARDIOLOGY,US,NEW YORK, IEEE, 1996, pages 9-12, XP000687747 ISBN: 0-7803-3711-5 abstract page 11, left-hand column, paragraph 2.3 ---	8-21
X	JP 10 165401 A (GE YOKOGAWA MEDICAL SYST LTD.) 23 June 1998 (1998-06-23)	44
Y	the whole document ---	24
X	JACOB G ET AL: "Robust contour tracking in echocardiographic sequences" SIXTH INTERNATIONAL CONFERENCE ON COMPUTER VISION (IEEE CAT. NO.98CH36271), PROCEEDINGS OF IEEE 6TH INTERNATIONAL CONFERENCE ON COMPUTER VISION, BOMBAY, INDIA, 4-7 JAN. 1998, pages 408-413, XP002155450 1998, New Delhi, India, Narosa Publishing House, India ISBN: 81-7319-221-9 cited in the application the whole document ---	41
X	US 5 669 382 A (RUPERT WILLIAM MELDRUM CURWEN ET AL.) 23 September 1997 (1997-09-23)	22
Y	claim 1 ---	23
Y	CHALANA V ET AL: "A MULTIPLE ACTIVE CONTOUR MODEL FOR CARDIAC BOUNDARY DETECTION ON ECHOCARDIOGRAPHIC SEQUENCES" IEEE TRANSACTIONS ON MEDICAL IMAGING,US,IEEE INC. NEW YORK, vol. 15, no. 3, 1 June 1996 (1996-06-01), pages 290-298, XP000587923 ISSN: 0278-0062 page 292, right-hand column, paragraph B. -page 293, right-hand column, paragraph D. ---	24
Y	KASS M ET AL: "SNAKES: ACTIVE CONTOUR MODELS" LONDON, JUNE 8 - 11, 1987,WASHINGTON, IEEE COMP. SOC. PRESS,US, vol. CONF. 1, 8 June 1987 (1987-06-08), pages 259-268, XP000971219 abstract -----	23

INTERNATIONAL SEARCH REPORT

[redacted]tion on patent family members

International Application No
[redacted]T/GB 00/02767

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 10165401 A	23-06-1998	NONE	
US 5669382 A	23-09-1997	CN 1194812 A	07-10-1998
		DE 19746939 A	28-05-1998
		JP 10229979 A	02-09-1998